Kinematics of quasi- and deep-inelastic reactions: ^{55}Mn, ^{65}Cu + ^{197}Au

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Since several neutron-rich nuclei between Z = 20 – 28 are refractory in their nature, they are rarely available as a low energy Radioactive Ion Beams (RIB) in ordinary Isotope Separator On-Line (ISOL) facilities [1-4]. These low energy RIBs would be especially interesting to have available in facilities which allow high-resolution beta-decay spectroscopy, ion-trapping, laser-spectroscopy and re-acceleration. As an example, in such facilities availability of those beams would open a way for research which would produce interesting and important data on neutron-rich nuclei around the doubly magic ^{78}Ni. One way to overcome the chemical difficulty of these beams is to rely on the chemically unselective Ion Guide Isotope Separator On-Line (IGISOL) technique [5]. To be able to produce the nuclei in question in the existing IGISOL facilities, quasi- and deep-inelastic reactions could be used. In general, the main complication with quasi- and deep-inelastic reactions, from the IGISOL point of view, is the high kinetic energy of the projectile like products, since they are finally thermalized into a relatively small volume filled with a noble gas (typically He or Ar). As a result, the energy and angular distributions of projectile like products must be studied in advance. Here we wish to report on such studies made for ^{55}Mn and ^{65}Cu induced reactions on ^{197}Au.

The above mentioned studies were performed at the Lawrence Berkeley National Laboratory using its 88″ cyclotron and a large scattering chamber [6]. The ^{55}Mn^{+13} and ^{65}Cu^{+17} beams were created using the ECR-source and they were accelerated up to 341 and 403 MeV final energies. Available beam intensities on target were a few pnA. To achieve optimum experimental conditions (beam hitting perpendicularly to the target and a small beam spot (about 2 mm × 5 mm)), two collimators were installed upstream of the target ladder. The target ladder held three Au targets: 1.5, 1.93 and 2.6 mg/cm^2. A ΔE (thickness 13 μm) – E (thickness 150 μm) Si-detector telescope was mounted about 15 cm from the target in a movable arm. A 2 mm × 5 mm collimator was placed in front of the Si-telescope. A monitoring Si-detector (thickness 500 μm) was mounted in a second movable arm at about the same distance from the target. It was also equipped with a collimator.

To be able to generate an adequate understanding of the kinematics of the selected reactions, several measurements at angles from 30^o to 70^o in the laboratory frame of reference were performed. As an example of the quality of the data, Fig. 1a and b represent the ΔE – E matrix measured at 60^o in the laboratory frame of reference for both beams ^{65}Cu and ^{55}Mn. As shown in Fig. 1, with these two primary beams, one is able to cover all the elements from Cu to Sc. Final analysis of the experimental data is in progress and an initial experiment using the Jyväskylä IGISOL facility is being planned. At Jyväskylä, high-resolution beta-decay spectroscopy using isobarically purified beams, ion-trapping and laser-spectroscopy is possible.

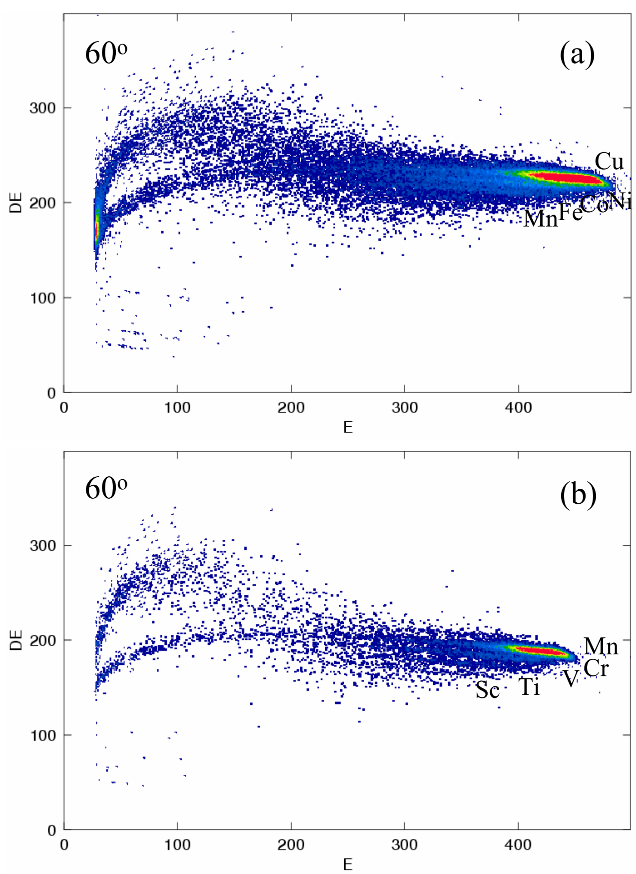

FIG. 1: (a) ΔE-E graph for the 403 MeV ^{65}Cu + ^{197}Au (1.5 mg/cm^2) reaction at 60 degrees, (b) ΔE-E graph for the 341 MeV ^{55}Mn + ^{197}Au (1.5 mg/cm^2) reaction at 60 degrees.

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